

NEW SPECIES OF PARASITIC NEMATODES FROM *DORCOPSULUS*
VANHEURNI (MARSUPIALIA : MACROPODIDAE)
FROM PAPUA NEW GUINEA

by I. BEVERIDGE* & R. SPEARE†

Summary

BEVERIDGE, I. & SPEARE, R. (1999) New species of parasitic nematodes from *Dorcopsulus vanheurni* (Marsupialia: Macropodidae) from Papua New Guinea. *Trans. R. Soc. S. Aust.* 123 (3), 85-100, 30 November, 1999.

Seven new species of *Cloacina* are described from the stomach of the lesser forest wallaby, *Dorcopsulus vanheurni*, from a single locality, Doïdo, in Papua New Guinea. *Cloacina siphax* sp. nov. differs from all congeners by the undulating anterior margin of its buccal capsule, lack of lips and acutely pointed tips to the submedian cephalic papillae. *Cloacina sancus* sp. nov. is distinguished by the shape of its buccal capsule which is sinuous in apical view, quadrangular in shape and has eight medially directed lobes. *Cloacina solon* sp. nov. is differentiated by its cervical cuticular inflation, submedian cephalic papillae with obtuse distal segments, a sinuous anterior margin to the buccal capsule and an unornamented oesophagus. *Cloacina sappho* sp. nov. can be separated from congeners by the long, acute submedian cephalic papillae and the presence of the amphids on elevations of the cuticle while *C. scinn* sp. nov. is distinguished by its cervical inflation, single oesophageal denticle, deirid at the level of the nerve ring and eight leaf crown elements. *Cloacina sterope* sp. nov. can be differentiated from congeners by the asymmetry of the buccal capsule in lateral view, the presence of oesophageal bosses and a denticle, the deirid posterior to the nerve ring and a straight vagina. *Cloacina solymus* sp. nov. is distinguishable by the tiny submedian cephalic papillae, sinuous anterior margin of the buccal capsule and sub-cylindrical oesophagus. Additional undescribed species were found but insufficient material was available to permit description.

KEY WORDS: *Dorcopsulus vanheurni*, nematodes, new species, *Cloacina*.

Introduction

Most species of kangaroos and wallabies which have been examined for the presence of internal parasites have been found to harbour a diverse array of parasitic nematodes, the majority belonging to the superfamily Strongyloidea Weinland, 1863 (Spratt *et al.* 1991). However, a number of species of wallabies has apparently never been examined for helminth parasites and prominent among them are the forest wallabies of the related genera *Dorcopsis* Schlegel & Mueller, 1842 and *Dorcopsulus* Matschie, 1916 from Papua New Guinea. During 1984, one of us (RS) had the opportunity to collect parasites from four specimens of the lesser forest wallaby, *Dorcopsulus vanheurni* (Thomas, 1922), at Doïdo in the Chimbu Province of Papua New Guinea (6° 33'S, 144° 50' E). New species of the nematode genus *Cloacina* von Linstow, 1898 found in the stomachs of the animals examined are described in this paper.

Materials and Methods

Stomach contents of wallabies were preserved in 10% formalin. In the laboratory, the contents were washed to remove the formalin, nematodes were extracted, washed in water and stored in 70% ethanol prior to examination. For identification, nematodes were cleared in lactophenol. Permanent preparations, on slides, of apical views of the mouth opening, bursa and spicule tips were made using polyvinyl lactophenol as the mounting medium. Measurements were made using an ocular micrometer and are presented in millimetres as the range followed by the mean in parentheses. In instances where all individual measurements were the same, a single figure appears before the mean in parentheses. If only two measurements were available, the individual measurements are given. Drawings were made with the aid of a drawing tube attached to an Olympus BH2 microscope using Nomarski interference optics. Drawings of apical views of the mouth opening are presented with the dorsal aspect uppermost; drawings of the bursa have the ventral lobes uppermost.

Terminology for morphological features of the genus *Cloacina* follows Beveridge (1998), except

* Department of Veterinary Science, The University of Melbourne, Parkville Vic. 3052.

† Department of Public Health & Tropical Medicine, James Cook University, Townsville Qld 4811.

that the term secretory-excretory (S-E) pore is used following Bird & Bird (1991). Holotype specimens have been deposited in the South Australian Museum, Adelaide (SAMA) while paratype material has been distributed between SAMA and the British Museum (Natural History), London (BMNH). Host nomenclature utilised is that of Flannery (1995). Following Beveridge (1998), the names of the new species are of classical origin.

Clouacina syphax sp. nov.
(FIGS 1-10)

Types. Holotype ♂ from stomach of *Dorcopsulus vanheurni*, Doido, Papua New Guinea, 17. v. 1984, coll. R. Speare, SAMA AHC 31199; allotype ♀, SAMA AHC 31200; paratypes: 20 ♂♂, 9 ♀♀, SAMA AHC 31201-2; 1 ♂, 1 ♀, BMNH 1998.9.28.21-22.

Description

Small nematodes; cervical cuticle slightly inflated in oesophageal region; transverse cuticular annulations prominent. Sub-median papillae elongate, 0.015 long, projecting anteriorly from perioral cuticle; proximal segment cylindrical, short, 0.005 long, shorter than ovoid, acute distal segment, 0.010 long. Buccal capsule shallow, cylindrical, symmetrical in dorsoventral views, circular in apical view. Dorsal margin of buccal capsule prominently lobed, with bifid lobes posterior to each submedian papilla. Eight leaf crown elements, with faint striations, arising from full length of internal wall of buccal capsule, recurved at tips. Peri-oral cuticle not inflated into lip-like lobes attached to each leaf crown element. Dorsal oesophageal gland not projecting into buccal capsule. Oesophagus simple; elongate, claviform; lining unornamented; denticles absent. Nerve ring in mid-oesophageal region; deirids in anterior oesophageal region, immediately anterior to nerve ring; S-E pore anterior to oesophago-intestinal junction.

Male (Measurements from 10 specimens, types) (Figs 5-8)

Total length 3.75-5.45 (4.63); maximum width 0.22-0.38 (0.31); dimensions of buccal capsule 0.018-0.020 (0.019) × 0.05-0.06 (0.055); oesophagus 0.47-0.60 (0.55); nerve ring to anterior end 0.22-0.26 (0.24); S-E pore to anterior end 0.39-0.50 (0.45); deirids to anterior end 0.18-0.26 (0.21). Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe slightly longer than lateral lobes. Dorsal ray slender at origin; primary branchlets arise at 1/2 length, before major bifurcation; secondary branchlets at 2/3 length; internal branchlets directed

posteriorly, reaching margin of bursa; external branchlets similar in length to internals, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa; anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Gubernaculum broadly triangular, 0.025, 0.030 long; central cordate and paired lateral thickenings of spicule sheaths present; genital cone with prominent anterior lip; posterior lip shorter than anterior, with pair of dome shaped papillae; pair of lateral inflations of cuticle present on either side of anterior lip; spicules elongate, 2.50-2.93 (2.73) long, alate, tip simple; ala diminishing in width gradually towards tip.

Female (Measurements from 5 specimens, types) (Figs 9, 10)

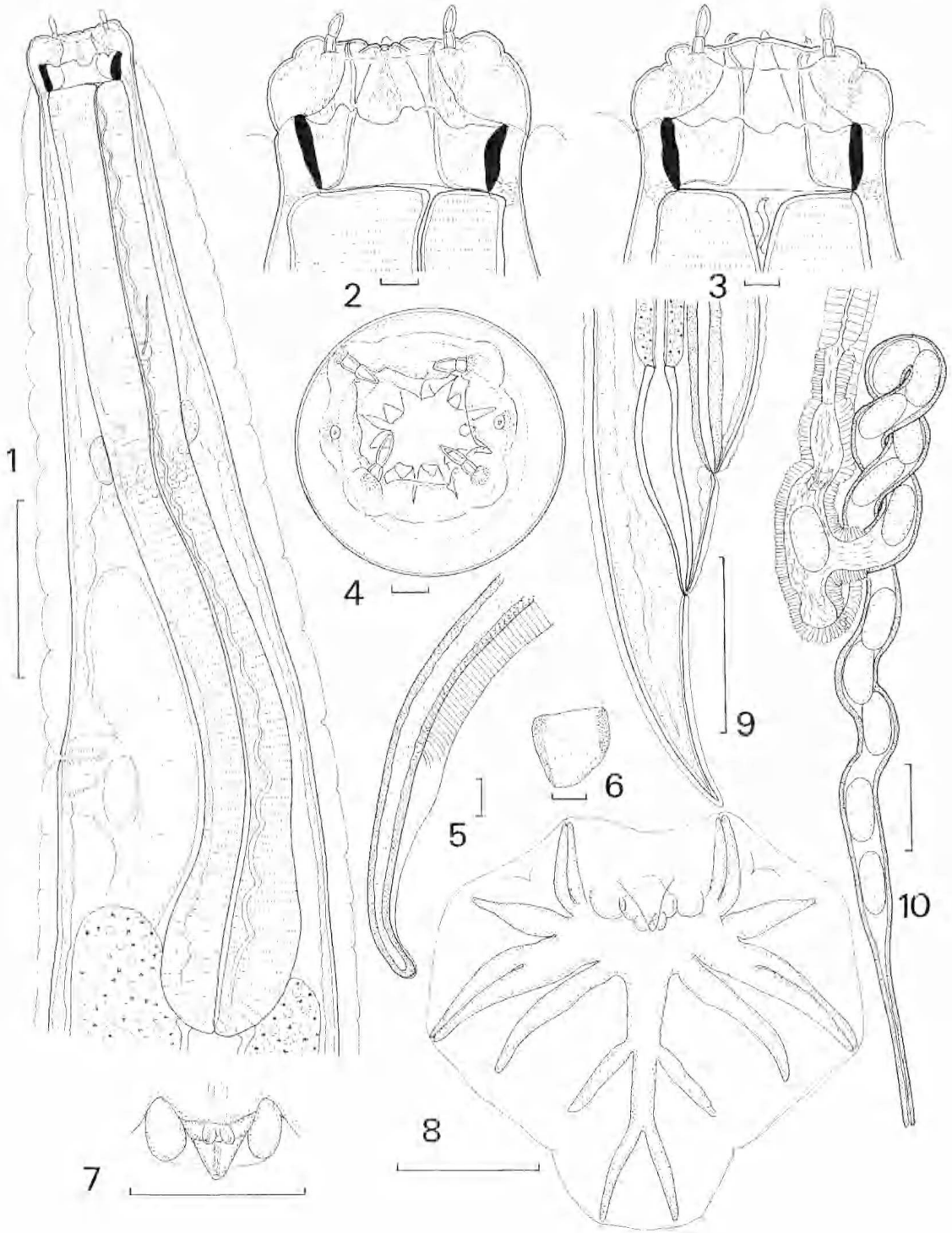
Total length 4.14-5.13 (4.59); maximum width 0.28-0.39 (0.33); dimensions of buccal capsule 0.020 (0.020) × 0.055-0.065 (0.060); oesophagus 0.58-0.61 (0.59); nerve ring to anterior end 0.25-0.27 (0.26); S-E pore to anterior end 0.37-0.46 (0.43); deirids to anterior end 0.18-0.23 (0.20). Tail simple, conical, 0.13-0.19 (0.14) long; vulva close to anus, 0.20-0.31 (0.23) from posterior end; vagina straight posteriorly; anterior region twisted, recurrent, 1.00-1.22 (1.13) long; ovejector J-shaped, infundibulum shorter than sphincter; egg ellipsoidal, 0.07-0.08 (0.07) × 0.04 (0.04).

Etymology

Syphax, king of Numidia at the time of the second Punic war.

Remarks

Clouacina syphax is distinguished from all congeners by the shape of the anterior margin of the buccal capsule which is undulate and has a roughly bifid, anteriorly directed lobe immediately posterior to each submedian papilla. Congeners with symmetrical buccal capsules bearing prominent anterior lobes are *C. artemis* Beveridge, 1998, *C. hebe* Beveridge, 1998, *C. hypsipyle* Beveridge, 1998, *C. linstowi* Johnston & Mawson, 1940, *C. thetidis* Johnston & Mawson, 1939 and *C. wallablae* Johnston & Mawson, 1939. The distal segments of the cephalic papillae in *C. hebe*, *C. hypsipyle*, *C. linstowi* and *C. thetidis* are obtuse at their tips rather than acute as in *C. syphax*; *C. artemis* and *C. wallablae* have lip-like expansions of the cephalic cuticle attached to each leaf crown element which are lacking in *C. syphax*. For these



Figs 1-10. *Cloacina syphax* sp. nov. 1. Anterior end, lateral view of δ . 2. Cephalic extremity, lateral view, dorsal aspect on right hand side. 3. Cephalic extremity, dorsal view. 4. Cephalic extremity, apical view. 5. Spicule tip, lateral view. 6. Gubernaculum, ventral view. 7. Genital cone, dorsal view. 8. Bursa, apical view. 9. Female tail, lateral view. 10. Ovejector and vagina, lateral view. Scale bars = 0.1 mm, 1, 7-10; 0.01 mm, 2-6.

reasons, *C. sylvax* is considered distinct from all congeners.

Cloacina sancus sp. nov.
(FIGS 11-23)

Types: Holotype ♂ from stomach of *Dorcopsulus vanheurni*, Dordo, Papua New Guinea, 17.v.1984, coll. R. Speare, SAMA AHC 31194; allotype ♀, same data, SAMA AHC 31195; paratypes, same data: 6 ♂♂, 2 ♀♀, SAMA AHC 31196; 1 ♂, BMNH 1998.9.28.15.

Description

Small nematodes; cervical cuticle not inflated in oesophageal region; transverse cuticular annulations prominent. Sub-median papillae small, 0.010 long, projecting anteriorly from peri-oral cuticle; proximal segment cylindrical, short, 0.005 long, as long as ovoid, obtuse distal segment, 0.005 long. Buccal capsule shallow, cylindrical, symmetrical in dorsoventral views, not sinuous or lobed in dorsoventral views but sinuous in apical view, with medially directed indentations posterior to each amphid and submedian papilla as well as one dorsal and one ventral indentation. Eight leaf crown elements, with faint striations, arising from full length of internal wall of buccal capsule, not recurved at tips. Peri-oral cuticle striated, not inflated into lip-like lobes attached to each leaf crown element. Dorsal and subventral oesophageal teeth absent. Oesophagus simple, claviform, slightly constricted at level of nerve ring, lining not ornamented; denticles absent. Nerve ring in mid-oesophageal region; deirids in anterior oesophageal region, anterior to nerve ring; S-E pore anterior to oesophago-intestinal junction.

Male (Measurements from 9 specimens, types) (Figs 18-21)

Total length 4.82-6.62 (5.84); maximum width 0.40-0.52 (0.45); dimensions of buccal capsule 0.020-0.025 (0.022) x 0.065-0.080 (0.075); oesophagus 0.68-0.75 (0.71); nerve ring to anterior end 0.34-0.38 (0.36); S-E pore to anterior end 0.55-0.64 (0.60); deirids to anterior end 0.22-0.27 (0.25). Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe similar in length to lateral lobes. Dorsal ray divides at midlength; secondary subdivisions at $\frac{3}{4}$ length; internal branchlets directed posteriorly, not reaching margin of bursa; external branchlets shorter than internals, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa;

anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Gubernaculum broadly quadrangular, 0.025-0.040 (0.032) long; central cordate and paired lateral thickenings of spicule sheaths present; genital cone with prominent anterior lip; posterior lip shorter than anterior lip, with pair of dome shaped papillae; pair of lateral inflations of cuticle present on either side of anterior lip; spicules elongate, 1.73-2.67 (2.25) long, alate, tip simple; ala diminishing in width gradually then terminating abruptly immediately anterior to tip.

Female (Measurements from 3 specimens, types) (Figs 22, 23)

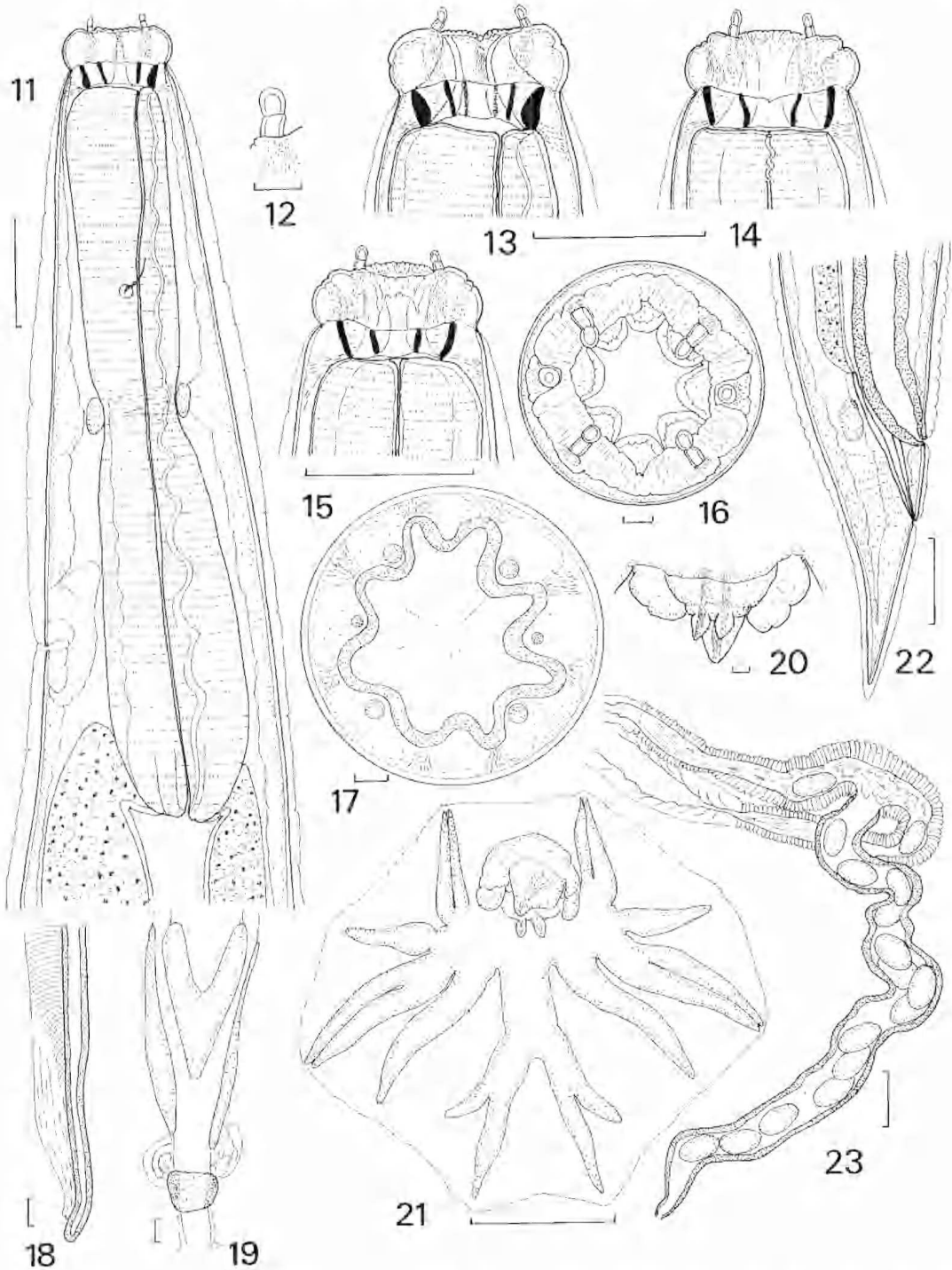
Total length 5.5-11.2 (7.8); maximum width 0.41-0.74 (0.60); dimensions of buccal capsule 0.020-0.025 (0.022) x 0.080-0.105 (0.090); oesophagus 0.79-0.88 (0.84); nerve ring to anterior end 0.38-0.40 (0.39); S-E pore to anterior end 0.50-0.74 (0.62); deirids to anterior end 0.21. Tail simple, conical, 0.19, 0.21 long; vulva close to anus, 0.30, 0.32 from posterior end; vagina sinuous, 0.67, 0.86 long; oyejector J-shaped, infundibulum as long as sphincter; egg ellipsoidal, 0.07, 0.08 x 0.04, 0.04.

Etymology

Sancus, a deity of the Sabines.

Remarks

Cloacina sancus is distinguished from all congeners except *C. bancroftorum* Johnston & Mawson, 1939 and *C. thetidis* by the shape of the buccal capsule, which is sinuous in apical views. The sinuosity is distinguishable in lateral views (Fig. 13) by the presence of two vertical thickenings of the buccal capsule wall. Similar thickenings of the wall are visible in dorsal and ventral views (Figs 14, 15). In both *C. bancroftorum* and *C. thetidis*, the shape of the buccal capsule in apical view is approximately triangular with six indentations of the margin. In *C. sancus*, the buccal capsule is roughly quadrangular in apical view and has eight indentations of its margin, six associated with amphids and submedian papillae as well as a dorsal and a ventral indentation. The wall of the buccal capsule is straight in lateral views in *C. sancus* and *C. thetidis* but is undulating in *C. bancroftorum*. The submedian papillae of *C. sancus* resemble those of *C. bancroftorum*, with a short, rounded distal segment, while those of *C. thetidis* have an elongate, obtuse distal segment. In the female, the oyejector of *C. thetidis* is Y-shaped compared with J-shaped oyejectors in *C. sancus* and *C. bancroftorum*, while the vagina is recurrent in *C. bancroftorum* but not in *C. sancus*.



Figs 11-23. *Cloacina sancus* sp. nov. 11. Anterior end, lateral view of ♂. 12. Submedian cephalic papilla. 13. Cephalic extremity, lateral view, dorsal aspect on right hand side. 14. Cephalic extremity, dorsal view. 15. Cephalic extremity, ventral view. 16. Cephalic extremity, apical view. 17. Optical transverse section through buccal capsule. 18. Spicule tip, lateral view. 19. Gubernaculum and thickenings of spicule sheaths, ventral view. 20. Genital cone, dorsal view. 21. Bursa, apical view. 22. Female tail, lateral view. 23. Ovejector and vagina, lateral view. Scale bars = 0.1 mm, 11, 13-15, 21-23; 0.01 mm, 12, 16-20.

Cloacina solon sp. nov.
(FIGS 24-34)

Types: Holotype ♂ from stomach of *Dorcopsulus vanheurni*, Doido, Papua New Guinea, 17.v.1984, coll. R. Speare, SAMA AHC 31203; allotype ♀, same data, SAMA AHC 31204; paratypes: 2 ♂♂, 3 ♀♀, SAMA AHC 31205; 1 ♂, 1 ♀, BMNH 1998.9.28.18-19.

Description

Small nematodes; cervical cuticle prominently inflated in oesophageal region; transverse cuticular annulations faint on cervical inflation, prominent posterior to it. Sub-median papillae elongate, 0.018 long, projecting anteriorly from peri-oral cuticle; proximal segment cylindrical, short, 0.006 long, shorter than ovoid, obtuse distal segment, 0.012 long. Buccal capsule shallow, cylindrical, symmetrical in dorsoventral views, circular in apical view; anterior margin of buccal capsule sinuous in lateral, dorsal and ventral views. Eight leaf crown elements, with faint striations, arising from full length of internal wall of buccal capsule, recurved at tips. Peri-oral cuticle not inflated into lip-like lobes attached to each leaf crown element. Dorsal oesophageal tooth absent; each sub-ventral sector of oesophagus with single, lancet-like projection into buccal capsule. Oesophagus simple, elongate, claviform; lining unornamented; denticles absent. Nerve ring in mid-oesophageal region; deirids in anterior oesophageal region, just anterior to nerve ring. S-E pore anterior to oesophago-intestinal junction.

Male (Measurements from 10 specimens, types) (Figs 29-32)

Total length 4.8-7.6 (5.5); maximum width 0.32-0.47 (0.41); dimensions of buccal capsule 0.015-0.018 (0.017) × 0.070-0.080 (0.075); oesophagus 0.70-0.83 (0.75); nerve ring to anterior end 0.27-0.32 (0.29); S-E pore to anterior end 0.52-0.63 (0.59); deirids to anterior end 0.19-0.26 (0.22). Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe similar in length to lateral lobes. Dorsal ray divides at $1/3$ length; secondary subdivisions at $2/3$ length; internal branchlets directed posteriorly, almost reaching margin of bursa; external branchlets shorter than internals, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa; anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Gubernaculum broadly quadrangular, 0.025-

0.030 (0.029) long; central cordate and paired lateral thickenings of spicule sheaths present; genital cone with prominent anterior lip; posterior lip shorter than anterior, with pair of dome shaped papillae; pair of lateral inflations of cuticle present on either side of anterior lip; spicules elongate, 2.60-2.94 (2.81) long; alate, tip simple; ala diminishing in width gradually, terminating near tip.

Female (Measurements from 10 specimens, types) (Figs 33, 34)

Total length 4.7-6.8 (6.0); maximum width 0.34-0.55 (0.46); dimensions of buccal capsule 0.015-0.020 (0.018) × 0.080-0.090 (0.085); oesophagus 0.71-0.86 (0.78); nerve ring to anterior end 0.22-0.30 (0.27); S-E pore to anterior end 0.53-0.67 (0.61); deirids to anterior end 0.20-0.23 (0.21). Tail simple, conical, 0.17-0.22 (0.19) long; vulva close to anus, 0.27-0.39 (0.32) from posterior end; vagina long, distal region straight, proximal region recurrent, 1.09-1.41 (1.21) long; ovejector J-shaped, infundibulum longer than sphincter; egg not seen.

Etymology

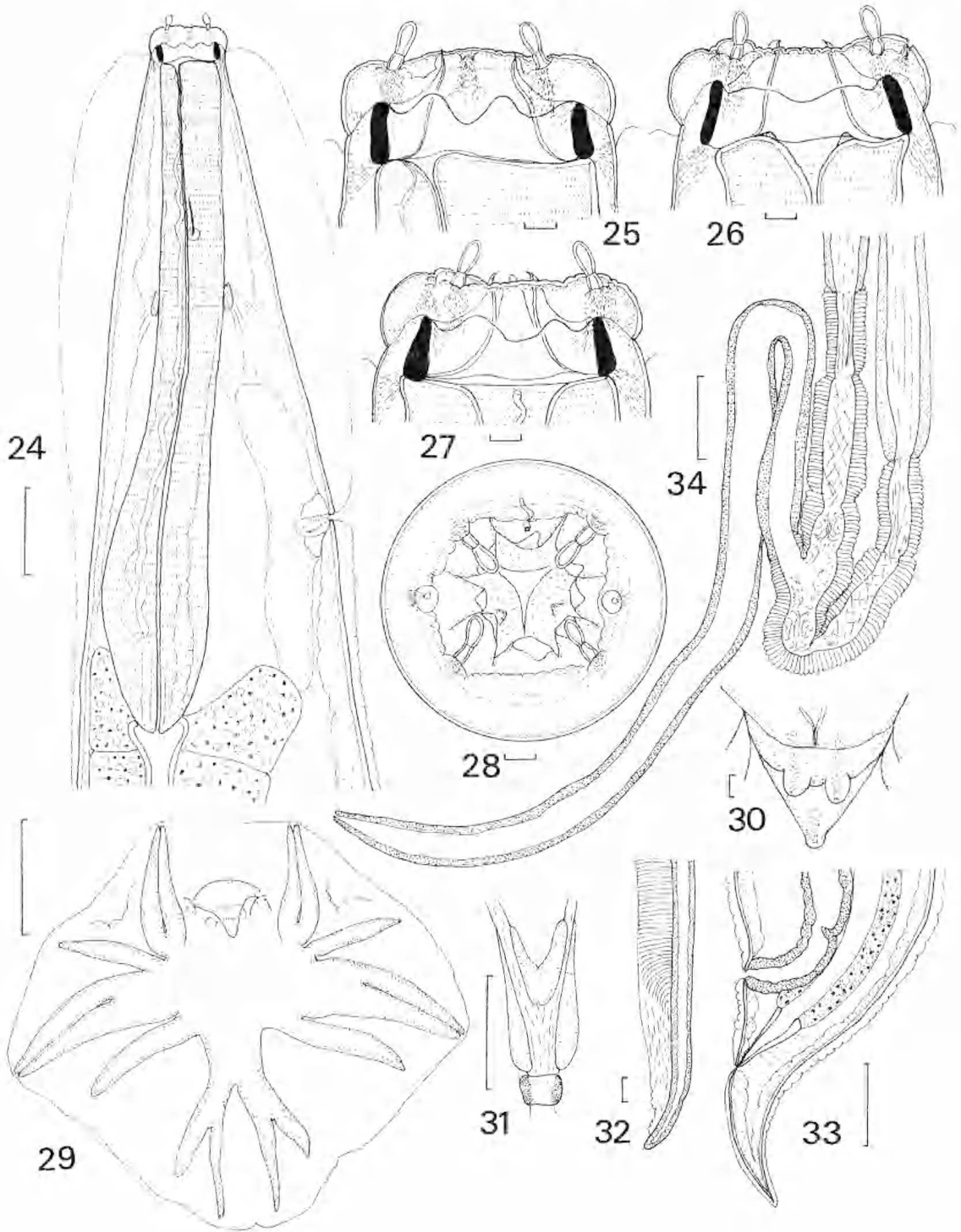
Solon, a famous legislator of Athens, one of the seven sages of Greece.

Remarks

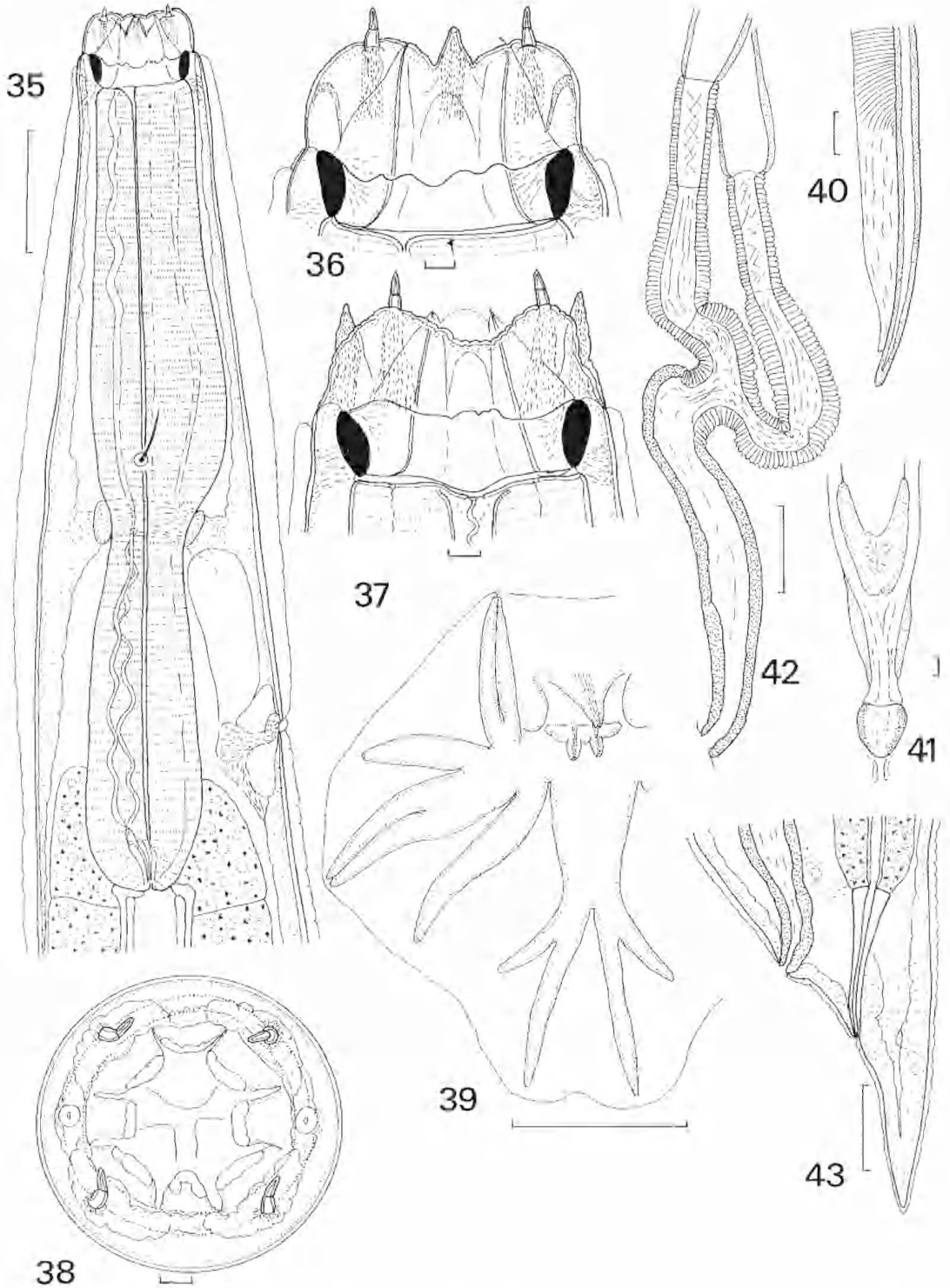
Cloacina solon is characterised by a simple, claviform, unornamented oesophagus, submedian cephalic papillae in which the proximal segment is short and the distal segment large and obtuse and by a buccal capsule which has a regularly sinuous anterior margin. These features distinguish it from all congeners except *C. dryope* Beveridge, 1998, *C. hebe*, *C. hypsipyle*, *C. linstowi*, *C. maia* Beveridge, 1998 and *C. thetidis*. *Cloacina dryope*, *C. hebe* and *C. thetidis* have extremely shallow buccal capsules which distinguish them immediately from *C. solon*, while *C. linstowi* and *C. maia* lack a cervical inflation of the cuticle and have Y-shaped ovejectors rather than the J-shaped ovejector found in *C. solon*. *Cloacina hypsipyle* possesses a buccal capsule which is triangular in apical view rather than circular as in *C. solon* and has six leaf crown elements rather than the eight in *C. solon*. In addition, the spicules of *C. hypsipyle* are 1.04-1.15 mm long compared with 2.60-2.94 mm in *C. solon* and the vagina of *C. hypsipyle* is straight while that of *C. solon* is recurrent.

Cloacina sappho sp. nov.
(FIGS 35-43)

Types: Holotype ♂ from stomach of *Dorcopsulus vanheurni*, Doido, Papua New Guinea, 17.v.1984.



Figs 24-34. *Cloacina solon* sp. nov. 24. Anterior end, lateral view of ♂. 25. Cephalic extremity, lateral view, dorsal aspect on left hand side. 26. Cephalic extremity, ventral view. 27. Cephalic extremity, dorsal view. 28. Cephalic extremity, apical view. 29. Bursa, apical view. 30. Genital cone, dorsal view. 31. Gubernaculum and thickenings of spicule sheaths, ventral view. 32. Spicule tip, lateral view. 33. Female tail, lateral view. 34. Ovejector and vagina, lateral view. Scale bars = 0.1 mm, 24, 29, 31, 33-34; 0.01 mm, 25-28, 30, 32.



Figs 35-43. *Cloacina sappho* sp. nov. 35. Anterior end, lateral view of ♂. 36. Cephalic extremity, lateral view, dorsal aspect on left hand side. 37. Cephalic extremity, dorsal view. 38. Cephalic extremity, apical view. 39. Bursa, apical view. 40. Spicule tip, lateral view. 41. Gubernaculum and thickenings of spicule sheaths, ventral view. 42. Ovejector and vagina, lateral view. 43. Female tail, lateral view. Scale bars = 0.1 mm, 35, 39, 42, 43; 0.01 mm 36-38, 40, 41.

coll. R. Speare, SAMA AHC 31188, allotype ♀, same data, SAMA AHC 31189; paratypes: 1 ♂, 1 ♀, SAMA AHC 31190.

Description

Small nematodes; cervical cuticle not inflated in oesophageal region; transverse cuticular annulations prominent. Sub-median papillae 0.013 long, projecting anteriorly from peri-oral cuticle, situated on elevations of peri-oral cuticle; proximal segment cylindrical, short, 0.005 long, shorter than acute, subtriangular distal segment, 0.009 long; amphids on prominent conical projections from peri-oral cuticle. Buccal capsule shallow, cylindrical, symmetrical in lateral views, circular in apical view; anterior margin of buccal capsule irregularly undulate. Eight leaf crown elements, with faint striations, arising from full length of internal wall of buccal capsule, not recurved at tips. Peri-oral cuticle not inflated into lip-like lobes attached to each leaf crown element. Dorsal oesophageal tooth absent. Oesophagus simple, claviform, region anterior to nerve ring broader than that posterior to nerve ring; lining unornamented; denticles absent. Nerve ring in posterior oesophageal region; deirids immediately anterior to nerve ring; S-E pore anterior to oesophago-intestinal junction.

Male (Measurements from 3 specimens, types) (Figs 39-41)

Total length 5.0-6.3 (5.7); maximum width 0.29-0.40 (0.35); dimensions of buccal capsule 0.018-0.020 (0.019) × 0.080-0.090 (0.085); oesophagus 0.65-0.71 (0.68); nerve ring to anterior end 0.40-0.43 (0.42); S-E pore to anterior end 0.58-0.60 (0.59); deirids to anterior end 0.26-0.36 (0.32). Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe similar in length to lateral lobes. Dorsal ray divides at midlength; secondary subdivisions immediately posterior to primary division; internal branchlets elongate, directed posteriorly, almost reaching margin of bursa; external branchlets shorter than internals, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa; anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Gubernaculum subtriangular, 0.030-0.040 (0.037) long; central cordate and paired lateral thickenings of spicule sheaths present; genital cone with prominent anterior lip; posterior lip shorter than anterior, with pair of dome shaped papillae; pair of lateral inflations of cuticle present on either side of

anterior lip; spicules elongate, 1.30-1.50 (1.38) long, alate.

Female (Measurements from 2 specimens, types) (Figs 42, 43)

Total length 5.9, 8.1; maximum width 0.46, 0.54; dimensions of buccal capsule 0.020, 0.020 × 0.100, 0.170; oesophagus 0.80, 0.87; nerve ring to anterior end 0.47, 0.53; S-E pore to anterior end 0.68, 0.77; deirids to anterior end 0.26, 0.29. Tail simple, conical, 0.21, 0.25 long; vulva close to anus, 0.33, 0.36 from posterior end; vagina straight, 0.44, 0.59 long; ojector J-shaped, infundibulum longer than sphincter; egg not seen.

Etymology

Sappho, a Greek lyric poetess.

Remarks

Although described from a very limited series of specimens, *C. sappho* is immediately distinguishable from all congeners by the irregularly undulating anterior margin of the buccal capsule and by the presence of prominent conical projections from the peri-oral cuticle, bearing the amphids. In addition, the shape of the oesophagus, with the anterior region broader than the posterior region, distinguishes the new species from all congeners except *C. dryope*, from which it differs in having a relatively deeper buccal capsule, a buccal capsule that is circular in apical view rather than dorsoventrally elongate as in *C. dryope*, in having eight rather than six leaf crown elements and in the shape of the cephalic papillae which in *C. dryope* terminate with an elongate, obtuse segment.

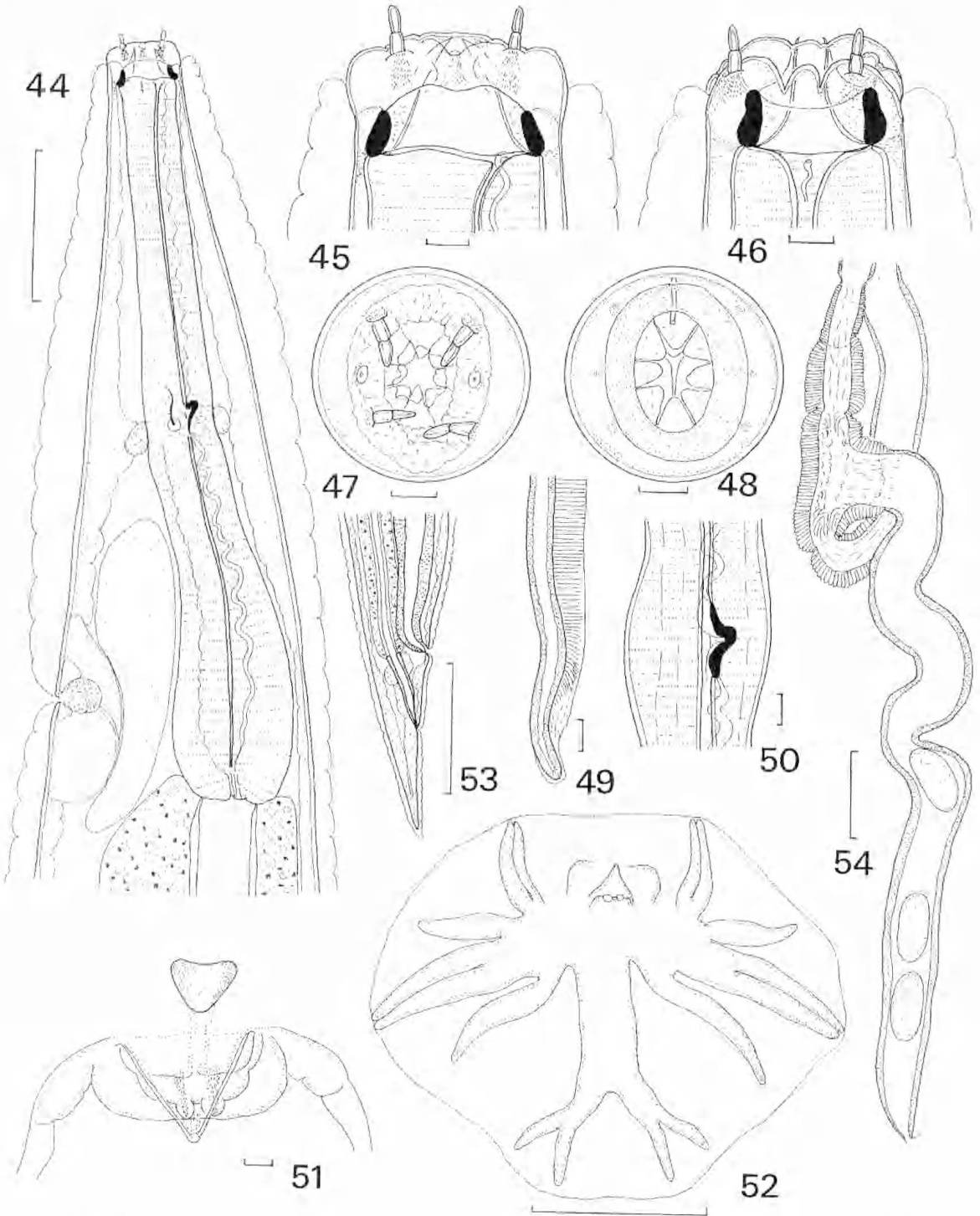
Cloacina sciron sp. nov.

(FIGS 44-54)

Types: Holotype ♂ from stomach of *Dorcopsulus vanheurni*, Doido, Papua New Guinea, 17.v.1984, coll. R. Speare, SAMA AHC 31207; allotype ♀, same data SAMA AHC 31208; paratypes: 18 ♂♂, 24 ♀♀, SAMA AHC 31209, 31210; 1 ♂, 1 ♀, BMNH 1998.9.28.16-17.

Description

Small nematodes; cervical cuticle inflated in oesophageal region, inflation originating at level of peri-oral cuticle; transverse cuticular annulations prominent. Sub-median papillae elongate, 0.011 long, projecting anteriorly from peri-oral cuticle; proximal segment cylindrical, 0.005 long, almost as long as ovoid, distal segment, 0.006 long. Buccal capsule shallow, cylindrical, symmetrical in dorsoventral views, dorsoventrally elongate in apical



Figs 44-54. *Cloacina sciron* sp. nov. 44. Anterior end, lateral view of δ . 45. Cephalic extremity, lateral view, dorsal aspect on right hand side. 46. Cephalic extremity, dorsal view. 47. Cephalic extremity, apical view. 48. Optical transverse section through buccal capsule. 49. Spicule tip, lateral view. 50. Oesophageal denticle, lateral view. 51. Gubernaculum and genital cone, ventral view. 52. Bursa, apical view. 53. Female tail, lateral view. 54. Ovejector and vagina, lateral view. Scale bars = 0.1 mm, 44, 52-54; 0.01 mm 45-51.

view; anterior margin of buccal capsule arched anteriorly in lateral views. Eight leaf crown elements, with faint striations, arising from full length of internal wall of buccal capsule, not recurved at tips. Peri-oral cuticle not inflated into lip-like lobes attached to each leaf crown element. Dorsal oesophageal tooth absent. Oesophagus simple, elongate, claviform, lining unornamented; single dorsal denticle present in mid-region of oesophagus. Nerve ring in mid-oesophageal region; deirids at level of nerve ring; S-E pore anterior to oesophago-intestinal junction.

Male (Measurements from 10 specimens, types) (Figs 49, 51, 52)

Total length 4.0-6.1 (4.5); maximum width 0.26-0.36 (0.32); dimensions of buccal capsule 0.008-0.010 (0.009) × 0.040-0.045 (0.043); oesophagus 0.45-0.51 (0.48); nerve ring to anterior end 0.24-0.27 (0.25); S-E pore to anterior end 0.37-0.50 (0.45); deirids to anterior end 0.27-0.35 (0.30). Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe similar in length to lateral lobes. Dorsal ray stout at origin, trunk long, divides at $\frac{2}{3}$ length; secondary subdivisions arise after primary division; internal branchlets directed posteriorly, almost reaching margin of bursa; external branchlets as long as internal, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa; anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Cubernaculum subtriangular, 0.02 (0.02) long; central cordate and paired lateral thickenings of spicule sheaths present; genital cone with prominent anterior lip; posterior lip shorter than anterior, with pair of dome shaped papillae; pair of lateral inflations of cuticle present on either side of anterior lip; spicules elongate, 2.83-3.30 (3.00) long, blunt, tip simple, recurved; *ala* diminishing in width gradually towards tip.

Female (Measurements from 10 specimens, types) (Figs 53, 54)

Total length 3.7-6.8 (4.8); maximum width 0.17-0.36 (0.31); dimensions of buccal capsule 0.010-0.013 (0.012) × 0.040-0.045 (0.044); oesophagus 0.44-0.55 (0.49); nerve ring to anterior end 0.24-0.27 (0.26); S-E pore to anterior end 0.38-0.57 (0.45); deirids to anterior end 0.25-0.38 (0.29). Tail simple, conical, 0.14-0.22 (0.18) long; vulva close to anus, 0.20-0.39 (0.29) from posterior end; vagina slightly sinuous, 0.78-1.10 (0.88) long; ovejector T-shaped, infundibulum as long as sphincter; egg ellipsoidal, 0.075-0.080 (0.079) × 0.040-0.045 (0.044).

Etymology

Sciron, an Epicurean philosopher.

Remarks

Cloacina sciron is characterised by a simple, clavate oesophagus with a dorsal denticle at the level of the nerve ring, the deirid at the level of the nerve ring, a cervical cuticular inflation and eight leaf crown elements. Species which most closely resemble *C. sciron* in possessing an unornamented oesophagus and a single dorsal oesophageal denticle are: *C. cornuta* (Davey & Wood, 1938), *C. dindymene* Beveridge, 1998, *C. dirce* Beveridge, 1998 and *C. longispiculata* Johnston & Mawson, 1939. *Cloacina cornuta* differs from *C. sciron* in having a prominent dorsal oesophageal tooth, *C. dindymene* and *C. dirce* have eight leaf crown elements, the deirid is in the anterior region of the oesophagus and, in addition, *C. dirce* has lips. *Cloacina longispiculata* has a cervical cuticular inflation which terminates posterior to the level seen in *C. sciron*, has an anteriorly placed deirid, the S-E pore lies posterior to the oesophago-intestinal junction and the female tail is blunt with a distinctive sinuous and slightly recurrent vagina.

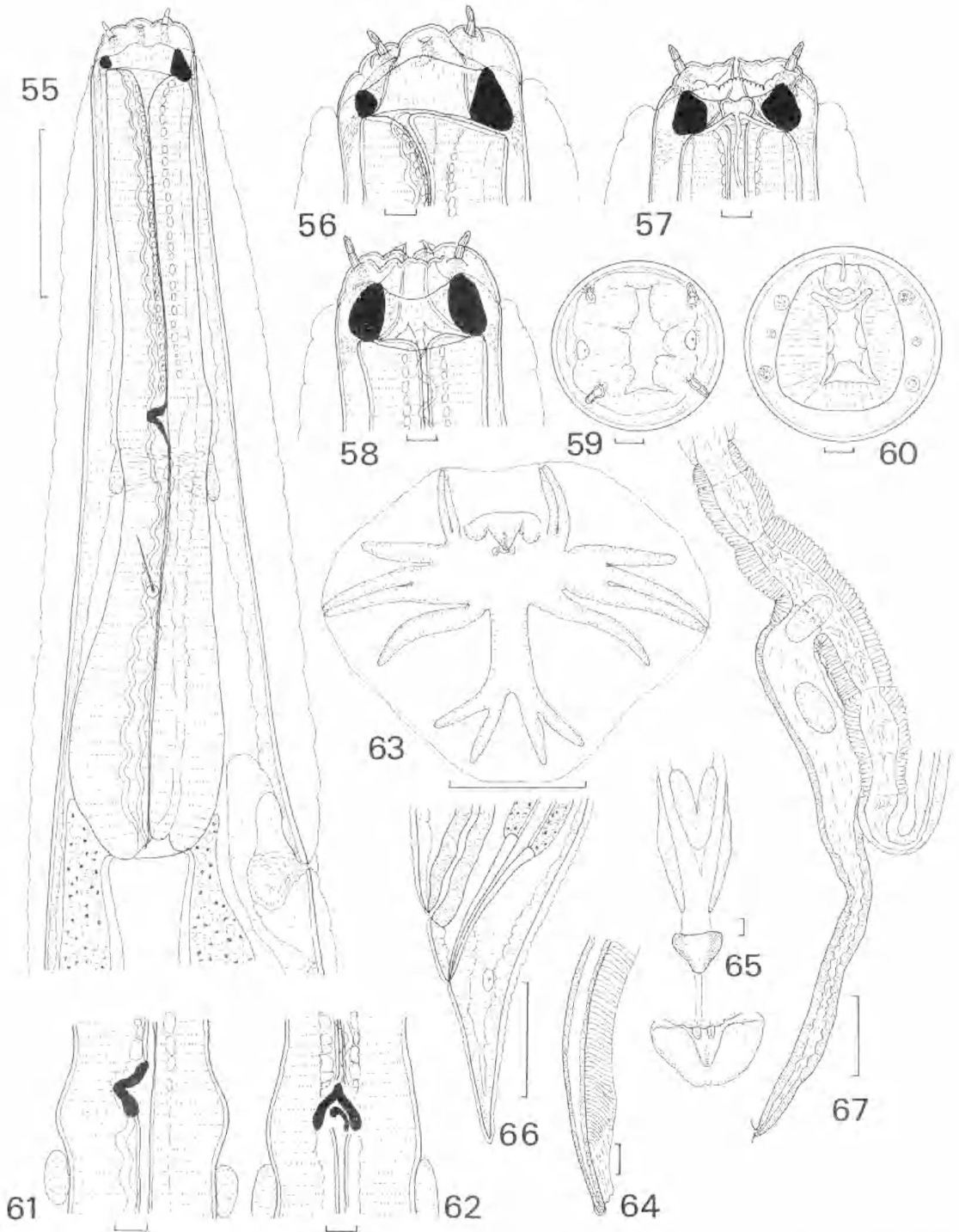
Cloacina sterope sp. nov.

(Figs 55-67)

Type: Holotype ♂ from stomach of *Dorcopsulus vanheurni*, Doido, Papua New Guinea, 17.v.1984, coll. R. Speare, SAMA AHC 31191; allotype ♀, same data, SAMA AHC 31192; paratypes: 8 ♂♂, 4 ♀♀, SAMA AHC 31193; 1 ♂, BMNH 1998.9.28.20.

Description

Small nematodes, cervical cuticle slightly inflated in oesophageal region; transverse cuticular annulations prominent. Sub-median papillae small, 0.010 long, projecting anteriorly from peri-oral cuticle; proximal segment cylindrical, 0.005 long, as long as ovoid, acute distal segment, 0.005 long. Buccal capsule shallow, cylindrical, asymmetrical in lateral views, with ventral wall of buccal capsule much thicker than dorsal wall; buccal capsule dorsoventrally elongate in apical view; anterior margin of buccal capsule bowed anteriorly in lateral view, concave in dorsal and ventral view. Eight leaf crown elements, arising from full length of internal wall of buccal capsule, not recurved at tips. Peri-oral cuticle not inflated into lip-like lobes attached to each leaf crown element. Dorsal oesophageal tooth projecting prominently into buccal capsule; each sub-ventral sector of oesophagus with lance-like tooth projecting into buccal capsule. Oesophagus



Figs 55-67. *Cloacina sterope* sp. nov. 55. Anterior end, lateral view of ♂. 56. Cephalic extremity, lateral view, dorsal aspect on left hand side. 57. Cephalic extremity, dorsal view. 58. Cephalic extremity, ventral view. 59. Cephalic extremity, apical view. 60. Optical transverse section through buccal capsule. 61. Oesophageal denticle, lateral view, dorsal aspect on left hand side. 62. Oesophageal denticle, dorsal view. 63. Bursa, apical view. 64. Spicule tip, lateral view. 65. Gubernaculum, genital cone and thickenings of spicule sheaths, ventral view. 66. Female tail, lateral view. 67. Ovejector and vagina, lateral view. Scale bars = 0.1 mm 55, 63, 66, 67; 0.01 mm, 56-62, 64, 65.

simple, claviform, with slight prececal swelling; lining ornamented with rows of sclerotised bosses extending from anterior end to nerve ring; single dorsal oesophageal denticle immediately anterior to nerve ring. Nerve ring in mid-oesophageal region; deirids immediately posterior to nerve ring, S-E pore at level of oesophago-intestinal junction.

Male (Measurements from 10 specimens, types) (Figs 63-65)

Total length 3.5-6.0 (4.8); maximum width 0.16-0.37 (0.29); dimensions of buccal capsule 0.015-0.023 (0.020) x 0.048-0.055 (0.053); oesophagus 0.39-0.49 (0.45); nerve ring to anterior end 0.23-0.27 (0.25); S-E pore to anterior end 0.42-0.52 (0.46); deirids to anterior end 0.28-0.37 (0.31). Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe similar in length to lateral lobes. Dorsal ray divides just after midlength; secondary subdivisions immediately after primary division; internal branchlets directed posteriorly, not reaching margin of bursa; external branchlets as long as laterals, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa; anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Gubernaculum broadly triangular, 0.020-0.030 (0.026) long; central cordate and paired lateral thickenings of spicule sheaths present; genital cone with prominent anterior lip; posterior lip shorter than anterior, with pair of dome-shaped papillae; pair of lateral inflations of cuticle present on either side of anterior lip; spicules elongate, 1.67-2.07 (1.96) long, alate, tip simple; alae diminishing in width gradually then ending abruptly at tip.

Female (Measurements from 5 specimens, types) (Figs 66, 67)

Total length 4.2-5.5 (4.4); maximum width 0.32-0.43 (0.38); dimensions of buccal capsule 0.015-0.020 (0.018) x 0.053-0.065 (0.062); oesophagus 0.46-0.52 (0.50); nerve ring to anterior end 0.23-0.26 (0.25); S-E pore to anterior end 0.35-0.46 (0.42); deirids to anterior end 0.28-0.30 (0.29). Tail simple, conical, 0.15-0.20 (0.19) long; vulva close to anus, 0.20-0.34 (0.30) from posterior end; vagina straight, 0.69-0.88 (0.72) long; oocytejector J-shaped, infundibulum longer than sphincter; egg ellipsoidal, 0.06-0.09 (0.08) x 0.03-0.04 (0.04).

Etymology

Sterope, one of the Pleiades.

Remarks

Cloucina sterope is characterised by a buccal capsule which is asymmetrical in lateral view, bosses lining the anterior half of the oesophageal lumen, a single dorsal oesophageal denticle, eight leaf crown elements and the deirids immediately posterior to the nerve ring. Of the species related to *C. sterope*, *C. antigone* Beveridge, 1998 differs in possessing an anteriorly placed deirid, a sinuous vagina and a cervical cuticular inflation. *C. australis* (Yorke & Maplestone, 1926) differs in possessing an anteriorly placed deirid, a sinuous vagina and large bosses at the anterior extremity of the oesophagus. *C. dis* Beveridge, 1998 differs in its anteriorly placed deirid, a spirally arranged vagina and submedian papillae with a very short distal segment. *C. eileithya* Beveridge, 1998 differs in the shape of the buccal capsule wall and in number of leaf crown elements. *C. hecuba* Beveridge, 1998 differs in the anterior position of the deirid and the convoluted vagina. *C. io* Beveridge, 1998 in the anterior position of the deirids and the slender distal segment to the submedian papilla. *C. leto* Beveridge, 1998 in the anterior deirids, the shape of the dorsal oesophageal tooth and the elongate, convoluted vagina. *C. minor* (Davey & Wood, 1938) in the anterior deirid and the shape of the dorsal ray. *C. papillata* Beveridge, 1979 in the presence of six leaf crown elements, cephalic papillae with a short distal segment and a recurrent vagina. *C. polyxena* Beveridge, 1998 in the anterior position of the deirid, the shape of the buccal capsule in dorsal view with its anterior loop over the dorsal oesophageal tooth and the extremely short vagina and *C. tyro* Beveridge, 1998 in the anterior deirid, the lack of sub-ventral oesophageal teeth and the sinuous vagina.

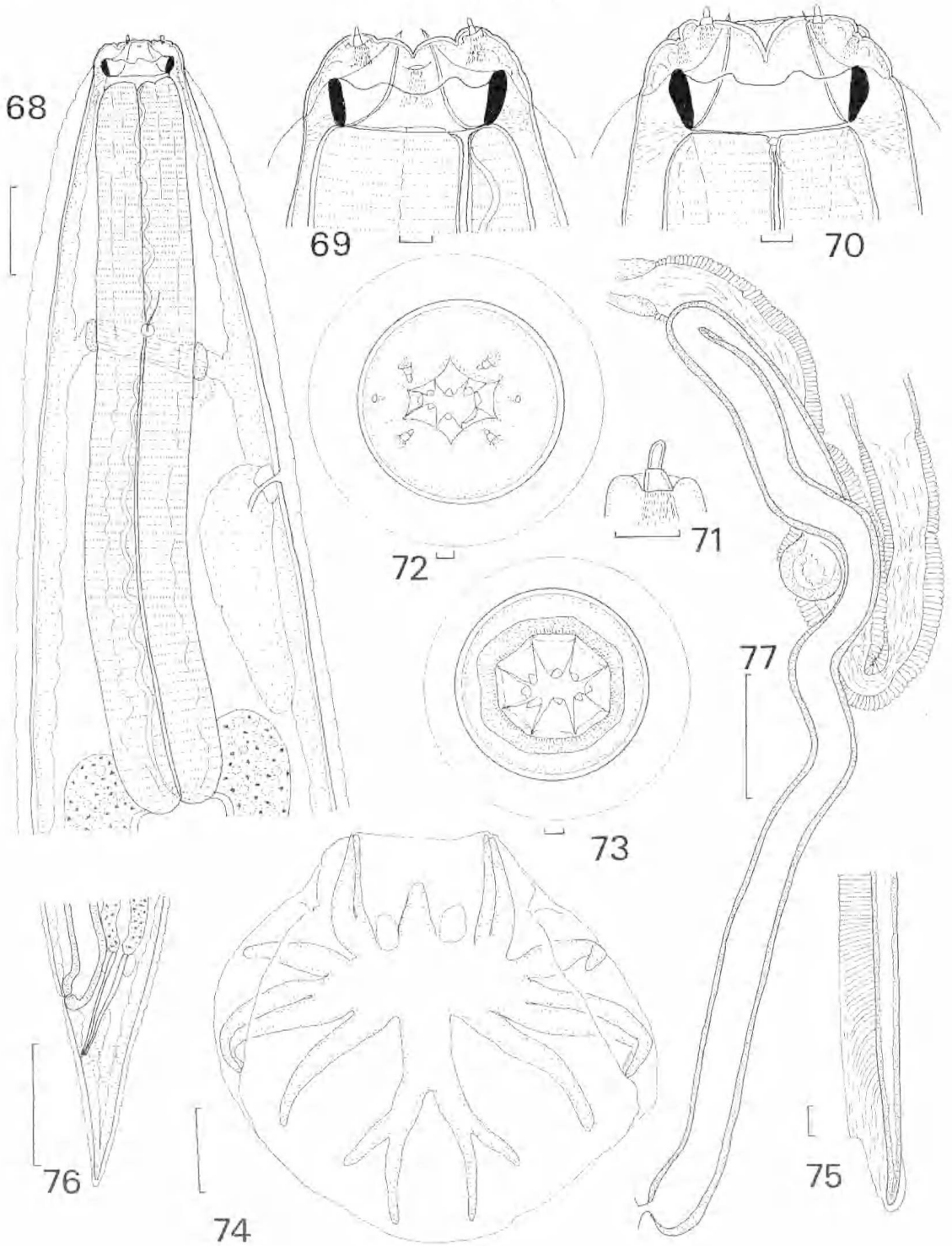
Cloucina solymus sp. nov.

(FIGS 68-77)

Types: Holotype ♂ from stomach of *Dorcopsulus bathemai*, Dondo, Papua New Guinea, 17.v.1984, coll. R. Speare; SAMA AHC 31197; allotype ♀, same data, SAMA AHC 31198.

Description

Small nematodes; cervical cuticle not inflated in oesophageal region; transverse cuticular annulations prominent. Sub-median papillae very small, 0.009 long, projecting anteriorly from slight depressions in the peri-oral cuticle; proximal segment cylindrical, short, 0.004 long, slightly shorter but wider than ovoid, distal segment, 0.005 long. Buccal capsule shallow, cylindrical, symmetrical in lateral and dorsal views, roughly octagonal in apical view; anterior margin of buccal capsule regularly sinuous



Figs 68-77. *Cloacina solymus* sp. nov. 68. Anterior end, lateral view of ♂. 69. Cephalic extremity, lateral view, dorsal aspect on right hand side. 70. Cephalic extremity, dorsal view. 71. Submedian cephalic papilla. 72. Cephalic extremity, apical view. 73. Optical transverse section through buccal capsule. 74. Bursa, apical view. 75. Spicule tip, lateral view. 76. Female tail, lateral view. 77. Ovejector and vagina, lateral view. Scale bars = 0.1 mm, 68, 74, 76, 77; 0.01 mm, 69-73, 75.

with anterior projection immediately posterior to each submedian papilla. Eight leaf crown elements, arising from full length of internal wall of buccal capsule, not recurved at tips. Peri-oral cuticle not inflated into lip-like lobes attached to each leaf crown element. Oesophagus simple, of almost uniform width; lining unornamented; denticles absent. Nerve ring in mid-oesophageal region; deirids at level of nerve ring; S-E pore anterior to oesophago-intestinal junction.

Male (Measurements from 2 specimens, types) (Figs 74, 75)

Total length 7.8, 8.6; maximum width 0.54, 0.55; dimensions of buccal capsule 0.020, 0.023 x 0.085, 0.085; oesophagus 0.85, 0.89; nerve ring to anterior end 0.34, 0.37; S-E pore to anterior end 0.55, 0.62; deirids to anterior end 0.34, 0.43. Bursa without prominent divisions between lobes. Ventral lobes joined ventrally; lateral and ventral lobes joined. Dorsal lobe similar in length to lateral lobes. Dorsal ray divides at midlength; secondary subdivisions at $\frac{3}{4}$ length; internal branchlets directed posteriorly, not reaching margin of bursa; external branchlets shorter than internals, directed posterolaterally, not reaching margin of bursa. Externodorsal ray arising close to lateral rays, not reaching margin of bursa. Posterolateral and ventrolateral rays apposed, reaching margin of bursa; anterolateral ray divergent, shorter than other lateral rays, not reaching margin of bursa; ventrolateral and ventroventral rays apposed, reaching margin of bursa. Genital cone with prominent anterior lip; pair of lateral inflations of cuticle present on either side of anterior lip; spicules elongate, 3.76, 3.79 long, alate, tip simple; all diminishing in width gradually towards tip.

Female (Measurements from allotype) (Figs 76, 77)

Total length 5.0; maximum width 0.32; dimensions of buccal capsule 0.023 x 0.080; oesophagus 0.80; nerve ring to anterior end 0.30; S-E pore to anterior end 0.46; deirids to anterior end 0.28. Tail simple, conical, 0.20 long; vulva close to anus, 0.29 from posterior end; vagina recurrent, 1.08 long; ojector J-shaped, infundibulum longer than sphincter; egg not seen.

Etymology

Solymus, a Trojan, the mythical founder of Solmo.

Remarks

Although only a small series of specimens was available for examination, *C. solymus* is a distinctive new species. It is characterised by a simple, unornamented oesophagus, symmetrical buccal capsule with a sinuous anterior margin, small

cephalic papillae, deirid at the level of the nerve ring and a recurrent vagina. Congeners with symmetrical buccal capsules and prominent anterior lobes are *C. artemis*, *C. hebe*, *C. hysipyle*, *C. linstowi*, *C. thetidis* and *C. wallabiae*. The distal segments of the cephalic papillae in *C. hebe*, *C. hysipyle*, *C. linstowi* and *C. thetidis* are much larger than the proximal segments and are obtuse at their tips rather than being small and narrower than the proximal segment as occurs in *C. solymus*, while *C. artemis* and *C. wallabiae* have lip-like expansions of the cephalic cuticle attached to each leaf crown element which are lacking in *C. solymus*.

Cloacina solymus also resembles *C. syphax*, *C. solon* and *C. sappho*, which occur in the same host, in the shape of the buccal capsule, but differs from these species in having very small submedian cephalic papillae.

Cloacina spp.

Additional undescribed species of *Cloacina* were present in the stomachs of the wallabies examined but were represented by single specimens only. Description of these species will have to await the collection of new material. The specimens have been deposited in SAMA (AHC 31182-5).

Discussion

The descriptions of new species presented here indicate that *Dorcopsulus vanheurni* harbours a diverse array of species of *Cloacina*. Only four animals were available for examination but the above findings suggest that collection of additional wallabies will reveal an even greater variety of nematodes. The helminths of macropodid marsupials from Papua New Guinea are poorly known with most available records (Spratt *et al.* 1991; Flannery *et al.* 1996) being based on the examination of a limited series of helminths collected from one or two host specimens.

The entire series of *Cloacina* spp. found in *D. vanheurni* is new and demonstrates a mixture of affinities with subgroupings within the genus. *Cloacina sterope*, characterised by an asymmetrical buccal capsule and an oesophagus lined with bosses, has affinities with a series of other species (*C. antigone*, *C. australis*, *C. dis*, *C. velleithya*, *C. hecuba*, *C. iq*, *C. leto*, *C. minor*, *C. papillata*, *C. polyena* and *C. tyro*) which occur in a range of species of macropodids (*Macropus agilis* (Gould, 1842), *M. dorsalis* (Gray, 1837), *M. giganteus* Shaw, 1790, *M. robustus* Gould, 1841, *Wallabia bicolor* (Desmarest, 1804)) in Australia (Beveridge 1998).

Cloacina sciron, by contrast, is characterised by a simple, unornamented oesophagus and a single

dorsal denticle. It therefore resembles a different series of species (*C. cornuta*, *C. diindymene*, *C. dirce* and *C. longispiculata*) again parasitic in macropodids (*Macropus agilis*, *M. robustus*, *M. antilopinus* (Gould, 1842)) in northern Australia (Beveridge 1998) while *C. sancus* has affinities with *C. bancroftorum* occurring in *M. dorsalis* in northeastern Australia.

The series of new species, *C. syphax*, *C. solon*, *C. sappho* and *C. solymus*, is characterised by a simple, unornamented oesophagus, lack of lips and a symmetrical buccal capsule with a sinuous anterior margin. While a parallel series of species (*C. hebe*, *C. hypsipyle*, *C. linstowi*, *C. thetidis*) occurs in *M. dorsalis* in Australia with similarly sinuous buccal capsule margins, the new species from Papua New Guinea are distinct in possessing eight leaf crown elements rather than six and in having the deirid either at the level of the nerve ring or just anterior to it rather than in the anterior

oesophageal region. In spite of these similarities, *C. syphax*, *C. solon*, *C. sappho* and *C. solymus* differ markedly in the shape of their cephalic papillae and the branching pattern of their dorsal rays. By contrast, *C. hebe*, *C. hypsipyle*, *C. linstowi*, and *C. thetidis* all have similar, distally obtuse cephalic papillae. The evidence available therefore suggests that the series of species *C. syphax*, *C. solon*, *C. sappho* and *C. solymus*, described here, may represent a unique subgrouping within the genus restricted to a single host species. This hypothesis remains to be tested both by more detailed anatomical comparisons of the as yet undescribed species of *Cloucina* present in *D. vanheurni* and by more extensive collecting from related host species in Papua New Guinea.

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References

- BEVERIDGE, I. (1998) Taxonomic revision of the genus *Cloucina* von Linstow (Nematoda: Strongyloidea) from macropodid marsupials. *Invert. Taxon.* **12**, 237-508.
- BIRD, A. F. & BIRD, J. (1991) "The Structure of Nematodes" 2nd edn (Academic Press, San Diego).
- FLANNERY, T. F. (1995) "Mammals of New Guinea" (Reed Books, New South Wales).
- _____, Martin, R. & Szalay, A. (1996) "Tree Kangaroos: a curious natural history" (Reed Books, Victoria).
- SPRATT, D. M., BEVERIDGE, I. & WALTER, E. L. (1991) A catalogue of Australian monotremes and marsupials and their recorded helminth parasites. *Rec. S. Aust. Mus., Monogr. Ser.* No. 1, 1-105.